920522-95773

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE THE APPLICATION OF	)	
	)	Examiner: Minh Nhut Tang
Bart De Cock, et al.	)	
	)	Group Art Unit: 2829
SERIAL NO. 10/805,972	)	
	)	Customer Number: 23644
FILED: March 22, 2004	)	
	)	
FOR: Device and Method for Detecting Rotor Speed of a Multiple Phase Motor with Bipolar Drive	)	

RESPONSE TO OFFICE ACTION DATED APRIL 28, 2006

Honorable Director of Patents and Trademarks
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Office Action of April 28, 2006, it is requested that the application be amended as follows:

In the Claims:

1.- (currently amended) A method for detecting rotation of a rotor of a multiple phase motor with bipolar drive, the motor comprising at least a first and a second energizable motor stator winding, the method comprising sequentially and alternately sensing a voltage on the first and the second motor stator winding at or near the end of a period of a non-energized state thereof,

wherein the method furthermore comprises storing the sensed voltage amplitude values of the first and second motor stator windings in a memory device.

2.- (previously presented) A method according to claim 1, wherein the sensing of the voltage on the first motor stator winding is carried out during energizing of the second motor stator winding, and wherein the sensing of the voltage on the second motor stator winding is carried out during energizing of the first motor stator winding.

3.- (previously presented) A method according to claim 1, wherein the sensing has a fixed or adjustable relative position in a non-energized state time-window.

4.- (cancelled)

5.- (previously presented) A method according to claim 1, furthermore comprising sensing multiple voltage samples, and storing the multiple samples in the memory device.

6.- (original) A method according to claim 1, wherein the motor is driven in microstepping operation.

7.- (original) A method according to claim 1, wherein the voltage is a back EMF.

8.- (original) A method according to claim 1, furthermore comprising outputting a detection signal indicative of a stalled condition of the motor.

9.- (original) A method according to claim 1, furthermore comprising outputting a detection signal indicative of a rotation of the motor rotor or derivatives thereof versus time.

10.- (previously presented) A method according to claim 1, where for sensing the voltage a unipolar signal is measured across one non-energized motor stator winding by connecting one terminal of the motor stator winding to a fixed or reference potential while measuring the voltage at an other terminal of that non-energized motor stator winding.

11.- (original) A method according to claim 1 excluding a three-phase motor with bipolar drive with star connected coils.

12.- (currently amended) An apparatus for detecting rotation of a rotor of a multiple phase motor with bipolar drive, the motor comprising at least a first and a second energizable motor stator winding, the apparatus comprising means for sequentially and alternately sensing a back electromagnetic force on the first and the second motor stator winding at or near the end of a period of a non-energized state thereof,
wherein the apparatus furthermore comprises means for storing the sensed voltage amplitude values of the first and second motor stator windings.

13.- (original) An apparatus according to claim 12, excluding a three-phase motor with bipolar drive with star connected coils.

14.- (previously presented) An apparatus according to claim 12, wherein the means for sequentially and alternately sensing has means for sensing of a voltage on the first motor stator winding during energizing of the second

motor stator winding and means for sensing of a voltage on the second motor stator winding during energizing of the first motor stator winding.

15.- (previously presented) An apparatus according to claim 12, wherein the means for sequentially and alternately sensing has a fixed or adjustable relative position in a non-energized state time-window.

16.- (cancelled).

17.- (previously presented) An apparatus according to claim 12, wherein the means for sensing has means for sensing multiple voltage samples, further comprising means for storing the multiple samples.

18.- (original) An apparatus according to claim 12, furthermore comprising means for outputting a detection signal indicative of a stalled condition of the motor.

19.- (original) An apparatus according to claim 12, furthermore comprising means for outputting a detection signal indicative of a rotation of the motor rotor or derivatives thereof versus time.

20.- (previously presented) An apparatus according to claim 12, further comprising means for sensing a unipolar signal across one non-energized motor stator winding by connecting one terminal of the motor stator winding to a fixed or reference potential while measuring the voltage at an other terminal of that non-energized motor stator winding.

Remarks

Reconsideration of the application is urged in view of the further amendments above and comments which follow.

I. Claim amendments

Claims 1 and 12 have been amended so as to clearly distinguish over US 4,851,755.

Claims 2, 3, 5 to 11, 13 to 15 and 17 to 20 have not been changed. Claims 4 and 16 were previously cancelled.

II. Support for the amendments

Support for the amendment in claims 1 and 12 can be found on page12 line 27 to page 13 line 4 of the application as originally filed.

III. Novelty and non-obviousness

US 4,851,755 describes a system and method for driving a stepper motor utilizing a near minimum amount of driving power (abstract).

In a preferred embodiment, during each consecutive step a different phase of the motor is deenergized to conserve power (abstract + Col. 4, lines 52-54). By stepping the motor, a voltage pulse is induced into the deenergized phase. The polarity and magnitude of that voltage pulse are examined after each step to determine whether the motor has actually stepped (abstract + Col. 5, lines 18-20).

However, the method according to US 4,851,755 does not comprise storing the sensed voltage amplitude values of the first and second motor stator winding in a memory device.

Therefore, amended claims 1 and 12 are not anticipated by US 4,851,755.

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The history register 56 in the device according to US 4,851,755 receives and stores a predetermined number of consecutive pulses applied thereto via line 65. These pulses are generated on line 65 by comparing the information on lines 61-64 with the information on line 66. The information on lines 61-64 is produced by amplitude and polarity detector 52 (see col. 6, line 35 to col. 13, line 8).

The information generated on lines 61-64 concerns whether or not the amplitude of the BEMF induced on phase A and B is either lower than a first threshold or higher than a second threshold (see col. 6, lines 48-53). That information is derived from and thus related to the amplitude of the BEMF pulses but is not the amplitude of the BEMF pulses. This information only indicates whether the amplitude is higher or lower than a predetermined value. The information on line 66 indicates which phase of the motor is energized and the correct polarity of the pulse induced into the deenergized winding which would result from actually stepping the rotor (see col. 6, lines 68 to col. 7, line 3).

Hence, the information generated on line 65 by the logic combination by circuit 54 of logic signals on line 61-64 and 66 is logic information in nature and may be related to the amplitude of the BEMF but is not the amplitude (analog information) of the BEMF pulses.

The present invention, on the other hand, proposes to store the amplitude voltage value measured across each phase of the motor stator winding. As

supported by the description on page 12, line 24 to page 13, line 4 of the application as originally filed, the stored sensed amplitude values are integrated, filtered, ..., and thus are further processed after being stored. The information contained in those stored sensed amplitude values is a lot richer than the information contained in the logic pulses as in US 4,851,755. The information contained in sensed amplitude values cannot even be restored/reconstructed from the logic information stored in the history register of the device according to US 4,851,755.

Hence, the above discussion can be summarized as follows:
In the device according to US 4,851,755 most of the information present in the voltage measured across a phase is destroyed by processing it before storing it, and it only stores whether the amplitude of the sensed voltage is higher or lower than a predetermined threshold value. In a device according to the present invention, on the other hand, the voltage amplitude values are stored before being further processed (see page 12, lines 26 to 33 and page 13, lines 1 to 4).

By storing the measured voltage amplitude values in a memory device, these voltage amplitude values can be used for further processing of the sensed voltage, e.g. back EMF, signal (see page 13, lines 7 to 22 of the present application). Comparator levels are adjusted with historical averages of previously sampled values (Vint in Fig. 4 or signal 35 in Fig. 6 of the present application). This leads to auto-adaptive thresholds in a closed-loop directly.

The present invention thus discloses an analog circuit that stores the sample back EMF in a tracking storage memory (Ci in Fig.4) to create a history record of the samples taken. The comparators 16 verify then whether the newly sampled back EMF is deviating much from the historical samples. Good samples are inside a window (i.e. small deviations from historical results). The comparator thresholds are adaptive and on the spot adjusted to the back EMF.

US 4,851,755 does not hint in the direction of storing full voltage values in a memory device and does also not disclose any further processing of the sensed voltage after being stored.

Because of the above, amended claims 1 and 12 are non-obvious in view of US 4,851,755 .

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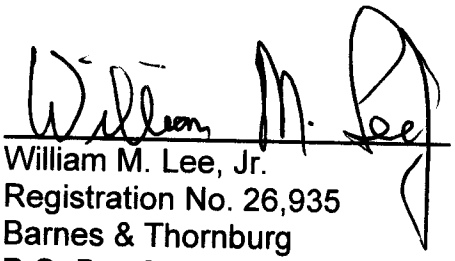
In virtue of their dependency on claim 1 or 12, claims 2, 3, 5 to 11, 13 to 15 and 17 to 20 are non-obvious, as well.

Therefore, it is submitted that the application is now in condition for allowance, and the Examiner's further and favorable reconsideration in that regard is urged.

July 27, 2006

Respectfully submitted,



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